

DETAILED ACTION

1. This action is in response to the papers filed October 22, 2010. Currently, claims 1-3, 5, 7-28 are pending. Claims 5, 14-28 have been withdrawn as drawn to non-elected subject matter.

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on October 22, 2010 has been entered.

3. It is noted that Claims 1-5, 7-21 have been provided in the copy of Claims presented October 22, 2010. There is no indication that Claims 22-28 have been cancelled, however they are not presented in the claim set filed October 22, 2010. Despite the lack of a complete copy of pending claims, since Claims 22-28 have been withdrawn, an action on the merits is issued. **Applicants are required to note the status of Claims 22-28 in any response.**

4. All arguments have been thoroughly reviewed but are deemed non-persuasive for the reasons which follow.

5. Any objections and rejections not reiterated below are hereby withdrawn.

6. This action contains new grounds of rejection.

7. In view of the amendments to the claims and the interview held on October 13, 2010, Applicant has switched their election of the invention to the combination of all

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SNPs shown in Table 2. Applicant acknowledges this election in the remarks by stating "Applicant has amended claim 1 to require identifying in the nucleic acid sample nucleotide occurrences of the eye color related SNPs shown in Table 2".

Priority

8. This application is a 371 of PCT/US05/004513, filed February 11, 2005 and claims benefit of 60/544,788, filed February 13, 2004 and 60/548,370, filed February 27, 2004.

It is noted that although both elected SNPs of SEQ ID NO: 3 and 4, rs1004611 and rs1874835 are mentioned in the provisional applications, neither of the disclosures teach how to infer an eye color based upon an allele. There is no teaching which allele is associated with which eye color.

It is noted that not all of the SNPs provided in Table 2, as now claimed, are presented in the provisional applications. For example, Table 2 contains SEQ ID NO: 26, 32-40 and 44-48 that do not appear to be in either provisional application.

Response to Arguments

The response asserts that one of skill in the art would understand how to infer eye color based upon an allele in view of Example 1 of PCT/US05/004513. Applicant has also included a scientific article authored by the inventor to support inference of eye color. This argument has been considered but is not convincing because the response fails to points to any teachings of how to infer eye color in the provisional applications.

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The provisional applications do not provide any teachings of allele and how to infer eye colors.

With respect to the Frudakis article, the article provides a table which provides genes and SNPs that are “marginally associated with iris pigmentation” (see page 2075). Looking at SEQ ID NO: 29, for example in the OCA2 gene, the HWE-P value is 0.81 which is not a significant p-value. The Table provides no guidance as to what one would infer in the event that a G was determined.

With respect to the SNPs not found in the provisional applications and not found in the publication, there is no guidance how to infer natural eye color of a human based upon these SNPs.

The instant claims do not receive benefit to the February 13, 2004 or February 27, 2004 provisional applications.

Drawings

9. The drawings are acceptable.

Claim Objections

10. Claim 2 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Claim 2 appears to require at least two eye color related SNPS of the OCA2 gene. Claim 1 however was amended to require all SNPs from Table 2 which includes more than 2 SNPs from the OCA2 gene already. Applicant is required to cancel the claim(s), or amend the claim(s)

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to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

11. Claim 3 is similarly objected to as Claim 1 requires a haplotype allele

Claim Rejections - 35 USC § 112-Scope of Enablement

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

12. Claims 1-3, 7-13 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for a method for detecting the SNPs at each of the positions in Table 2, does not reasonably provide enablement for a method of inferring natural eye color in a human subject based upon detecting each of the SNPs of Table 2. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

Factors to be considered in determining whether a disclosure meets the enablement requirement of 35 USC 112, first paragraph, have been described by the court in *In re Wands*, 8 USPQ2d 1400 (CA FC 1988). *Wands* states at page 1404,

“Factors to be considered in determining whether a disclosure would require undue experimentation have been summarized by the board in *Ex parte Forman*. They include (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims.”

The nature of the invention and breadth of claims

The claims are drawn to a method of inferring natural eye color in a human subject based upon detecting each of the SNPs in Table 2. Table 2 contains 32 SNPs.

The invention is in a class of invention which the CAFC has characterized as “the unpredictable arts such as chemistry and biology.” *Mycogen Plant Sci., Inc. v. Monsanto Co.*, 243 F.3d 1316, 1330 (Fed. Cir. 2001).

The unpredictability of the art and the state of the prior art

The art teaches the organization and sequence of the human P gene (Lee et al. *Genomics*, Vol. 26, pages 354-363, 1995). Mutations of the p gene result in type II oculocutaneous albinism (OCA2) in humans. Lee teaches the human OCA2 locus is mapped to 15q11-q13.

The OCA2 gene was formerly called the P gene.

Rebbeck et al. (*Cancer Epidemiology, Biomarkers and Prevention*, Vol. 11, pages 782-784, August 2002) teaches the p gene is an inherited biomarker of human eye color. Rebbeck teaches individuals were less likely to have blue or gray eyes if they had P gene variants (abstract). Rebbeck teaches eye color may be blue, gray, green, hazel, light brown, dark brown and black. Rebbeck use the following categories of eye color for analysis bleu/gray; green/hazel and brown/black (page 782, col. 2).

Frudakis et al. (*Genetics*, Vol. 165, pages 2071-2083, December 2003) teaches identifying numerous SNPs, haplotypes and diplotypes within OCA2, for example associated with iris color. The list of SNPs in Table 2 do not include the SNPs of SEQ ID NO: 3 and 4. Frudakis teaches haplotypes with 13 different SNPs that appear to be associated with various distinguishment of colors. For example sequence 1 of OCA2 distinguished blue from brown. And sequence 22 distinguishes green from blue. There are 6 haplotypes that do not distinguish any iris colors. For haplotypes as large as 13

SNPs, there are numerous combinations that fail to provide any guidance for iris color determination.

While the state of the art and level of skill in the art with regard to the detection of any known polymorphic allele is high, the level of unpredictability in associating any particular allele with a specific phenotype is even higher. The high level of unpredictability is demonstrated by the prior art, the post filing art, and the instant specification. There is a large body of knowledge in the prior art related to polymorphisms in general, and their association with phenotypes. However, the art is highly unpredictable with regard to the functionality of polymorphic sites in genomic DNA. After a screening assay identifies polymorphisms, it is unpredictable whether any such polymorphisms would be associated with any phenotypic trait, such as a disease state, physiological state, or drug metabolism or response. Lucentini (The Scientist; 2004, Vol 24, page 20) teaches that most gene association studies are typically wrong. Lucentini teaches that it is strikingly common for follow-up studies to find gene-disease associations wrong (left column, 3rd paragraph). Lucentini teaches that two recent studies found that typically when a finding is first published linking a given gene to a disease there is only roughly a one-third chance that the study will reliably confirm the finding (left column, 3rd paragraph). Lucentini teaches that bigger sample sizes and more family-based studies, along with revising statistical methods, should be included in the gene association studies (middle column, 1 st complete paragraph). In the instant case, the specification only provides information that the variant exists, but provides no guidance that it has any effect whatsoever on the CYP 1A1 gene, expression, or activity, let alone any potential diagnostic or therapeutic effect

The art teaches genetic variations and associations are often irreproducible. Hirschhorn et al. (Genetics in Medicine. Vol. 4, No. 2, pages 45-61, March 2002)

teaches that most reported associations are not robust. Of the 166 associations studied three or more times, only 6 have been consistently replicated. Hirschhorn *et al.* suggest a number of reasons for the irreproducibility of studies, suggesting population stratification, linkage disequilibrium, gene-gene or gene-environment interactions, and weak genetic effects and lack of power are possible factors that lead to such irreproducibility. Hirschhorn *et al.* caution that the current irreproducibility of most association studies should raise a cautionary alarm when considering their use as diagnostics and prognostics (p. 60, Col. 2). Thus, Hirschhorn cautions in drawing conclusions from a single report of an association between a genetic variant and disease susceptibility.

Additionally, Ioannidis (Nature Genetics, Vol. 29, pages 306-309, November 2001) teaches that the results of the first study correlate only modestly with subsequent research on the same association (abstract). Ioannidis teaches that both bias and genuine population diversity might explain why early association studies tend to overestimate the disease protection or predisposition conferred by a genetic polymorphism (abstract).

Guidance in the Specification.

The specification provides no evidence that the one of skill in the art could infer natural eye color of a human by detecting each of the 32 SNPs in Table 2. The specification teaches measuring iris colors with a cannon digital camera. 100 samples were collected. The specification teaches grouping the lightest 21 samples together and then grouping the darkest 21 samples together. The specification analyzes the samples for SNPs. 27 SNPs were used for further analysis. The specification teaches classification models incorporated 32 SNPs from Table 2. Table 2 comprises 32 SNPs.

Table 3 lists 10 SNPs that were particularly useful for inferring eye color and indicates the eye color shade that can be drawn for a particular allele. SEQ ID NO: 3 T is listed as darker and SEQ ID NO: 4 T is listed as darker. The specification teaches darker indicates brown or hazel eyes while lighter indicates blue or green eyes (page 26). The specification teaches that iris colors of 'unknown' samples based on the genotypes of 35 SNPs provided a blind classification accuracy of 97% when an exact match existed across all of the genotypes in Table 2. This seems to state that iris color could be inferred correctly 97% of the time if ALL 35 SNPs were correct. However Table 2, as claimed, is directed to only 32 SNPs. This provides no indication how to infer eye color based upon the presence of these 32 SNPs. Even more, there is no guidance what the "correct" color for the majority of the SNPs is. For example, SEQ ID NO: 26 is not found in Table 3 and Table 2 provides no indication of what eye color is associated with what allele. The specification states that the iris colors of known subjects may be used as a guide, however, the specification fails to provide a guide for each of the SNPs in Table 2 (para 59). The guidance provided by the specification amounts to an invitation for the skilled artisan to try and follow the disclosed instructions to make and use the claimed invention.

Quantity of Experimentation

The quantity of experimentation in this area is extremely large since there is significant number of parameters which would have to be studied to allow the skilled artisan to infer natural eye color of a human by detecting the 32 SNPs of Table 2. The specification appears to state that for a 97% accuracy, it takes 35 SNPs to match across all genotypes. The specification does not provide any discussion of what type of accuracy one might expect with the use of only 32 SNPs. Even more, the specification

is silent with respect to a vast number of SNPs. As noted above, SEQ ID NO: 26, for example, does not appear to have any indication of which alleles are associated with which particular iris color. It is unclear if an A, T, C or G is associated with light or dark eye color. The specification states that the iris colors of known subjects may be used as a guide, however, the specification fails to provide a guide for each of the SNPs in Table 2.

Moreover, it is unclear how the skilled artisan would infer eye color in the event ALL SNPs "were not correct". For example, if nucleotide 68 of SEQ ID NO: 3 were to indicate a darker eye shade and nucleotide 171 of SEQ ID NO: 4 were to indicate a lighter eye shade. There would be no reasonable inference to be made. Stated another way, it is unpredictable how one would infer natural eye color if half of the SNPs indicated dark eye color and the other half of the SNPs indicated light eye color.

Claim 1 has been amended to state that "a C residue at nucleotide 360 of SEQ ID NO: 10 indicates an increased likelihood of a darker eye shade". However, SEQ ID NO: 10 does not appear to be in Table 2. Thus it is unpredictable how to use this information since the claims does not require identifying the SNP of SEQ ID NO: 10.

Furthermore, it is unclear how one would infer natural eye color. Rebbeck teaches 7 categories of eye colors, namely blue, gray, green, hazel, light brown, dark brown and black. The specification only analyzes two categories: dark or light.

This would require significant inventive effort, with each of the many intervening steps, upon effective reduction to practice, not providing any guarantee of success in the succeeding steps.

Level of Skill in the Art

The level of skill in the art is deemed to be high.

Conclusion

In the instant case, as discussed above, in a highly unpredictable art where the association of SNPs with a particular phenotype is unpredictable, it is unclear how one could practice the claimed invention as broadly as claimed. Further, the prior art and the specification provides insufficient guidance to overcome the art recognized difficulties in association studies. Thus given the broad claims in an art whose nature is identified as unpredictable, the unpredictability of that art, the large quantity of research required to define these unpredictable variables, the lack of guidance provided in the specification, the absence of a working example and the negative teachings in the prior art balanced only against the high skill level in the art, it is the position of the examiner that it would require undue experimentation for one of skill in the art to perform the method of the claim as broadly written.

Response to Arguments

The response traverses the rejection. The response notes that the Claims have been amended. The response asserts that the specification enables the skilled artisan to genotype a sample and compare the result of the SNP genotyped to infer natural eye color. This argument has been considered but is not convincing because the specification does not provide any results for the panel of 32 SNPs in Table 2. In fact, the specification teaches the delta value (allele frequency differential) was used rather than a p-value because the p-value depends on the sample size. The specification acknowledges that a differential of 10% would be significant with a sample of 500 or so

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at the 0.05 level but not with a sample of 100. Here the delta value for SEQ ID NO: 3 and 4 is 2% and 11% respectively (see Table 3, page 26). Moreover, the sample size was much less than 100 (21 light and 21 dark eye colored samples) which the specification clearly states a 10% delta would not be significant with a sample of 100. Thus, it is clear that the specification fails to provide any statistically significant results for the skilled artisan to rely upon for inferring natural eye color. Without a significance level of at least 0.05, the results may be due to chance and not a true association that may be relied upon for inferring natural eye color.

The response further relies upon Table 2, however, Table 2 does not appear to provide any data of eye shade/alleles. Table 3 provides 10 SNPs and their delta and gene and allele/eye shade, but for the reasons discussed above, there is no significant association that the skilled artisan may reasonably infer natural eye color. It is unclear what the ordinary artisan would infer if SEQ ID NO: 3 was a T and SEQ ID NO: 4 was a G.

The response relies upon Exhibit A, but as discussed above, Exhibit A fails to address each of the SNPs in Table 2 and fails to provide how to infer based upon the SNPs provided in the reference.

Thus for the reasons above and those already of record, the rejection is maintained.

Claim Rejections - 35 USC § 112- Second Paragraph

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

13. Claims 1-3, 7-13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

A) The claims are drawn to a method for inferring natural eye color in a human subject by detecting the SNPs in Table 2. The final process step is merely drawn to comparing the identified nucleotide with known nucleotide occurrences. It is unclear whether the claims are drawn to inferring natural eye color or whether the claims are merely drawn to comparing the SNP in a nucleic acid sample to known nucleotides. Amending the final step of comparing to "inferring" natural eye color would complete the claim. The metes and bounds of the claimed invention are unclear.

B) Claim 1 has been amended to state that "a C residue at nucleotide 360 of SEQ ID NO: 10 indicates an increased likelihood of a darker eye shade". However, SEQ ID NO: 10 does not appear to be in Table 2. It is unclear how this limitation further limits the claims. It is unclear how the information will be used to infer eye color since SEQ ID NO: 10 is not identified, as it is not in Table 2.

Conclusion

14. **No claims allowable.**

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15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Jeanine Goldberg whose telephone number is (571) 272-0743. The examiner can normally be reached Monday-Friday from 7:00 a.m. to 4:00 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nguyen, can be reached on (571)272-0731.

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The Central Fax Number for official correspondence is (571) 273-8300.

/Jeanine Goldberg/

Primary Examiner

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